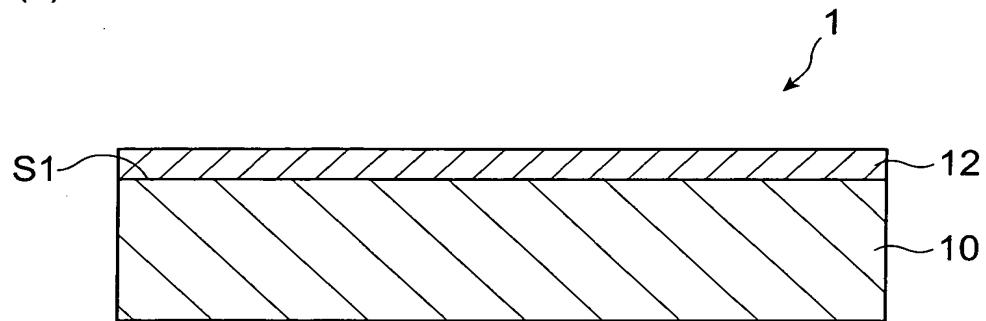


Fig. 1

(a)



(b)

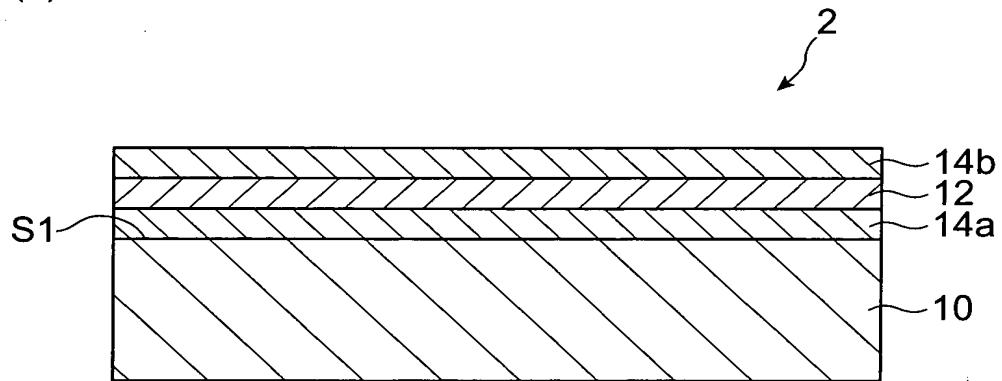
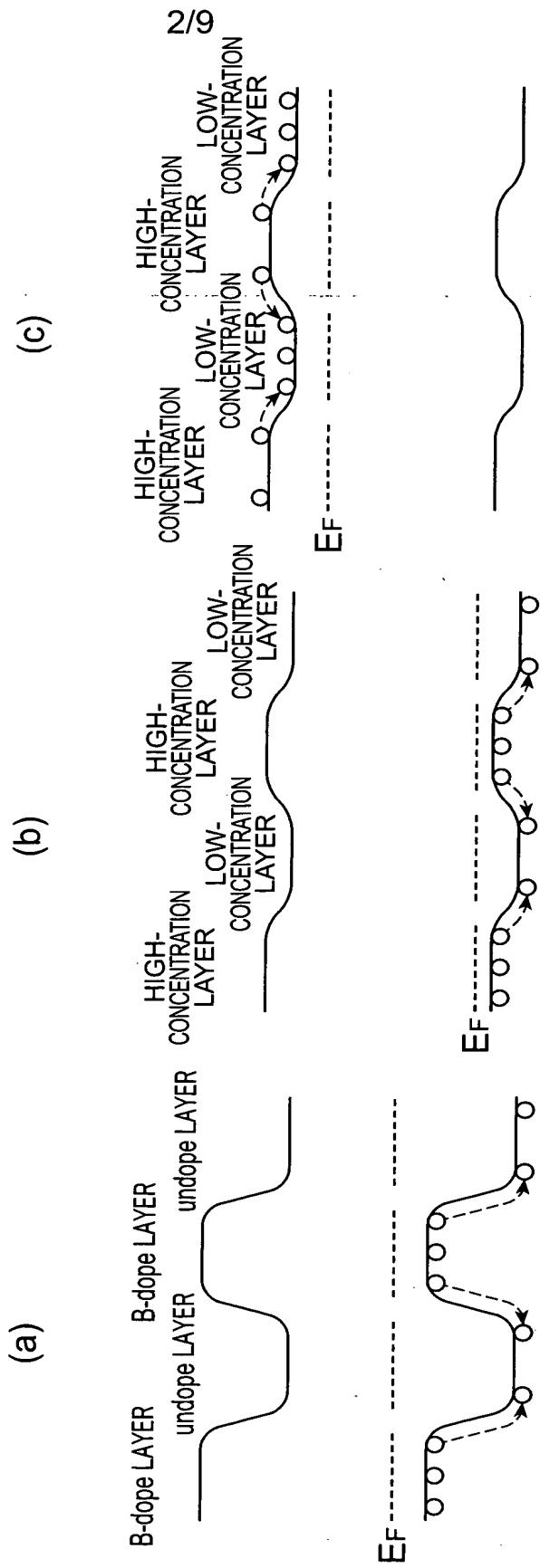


Fig.2

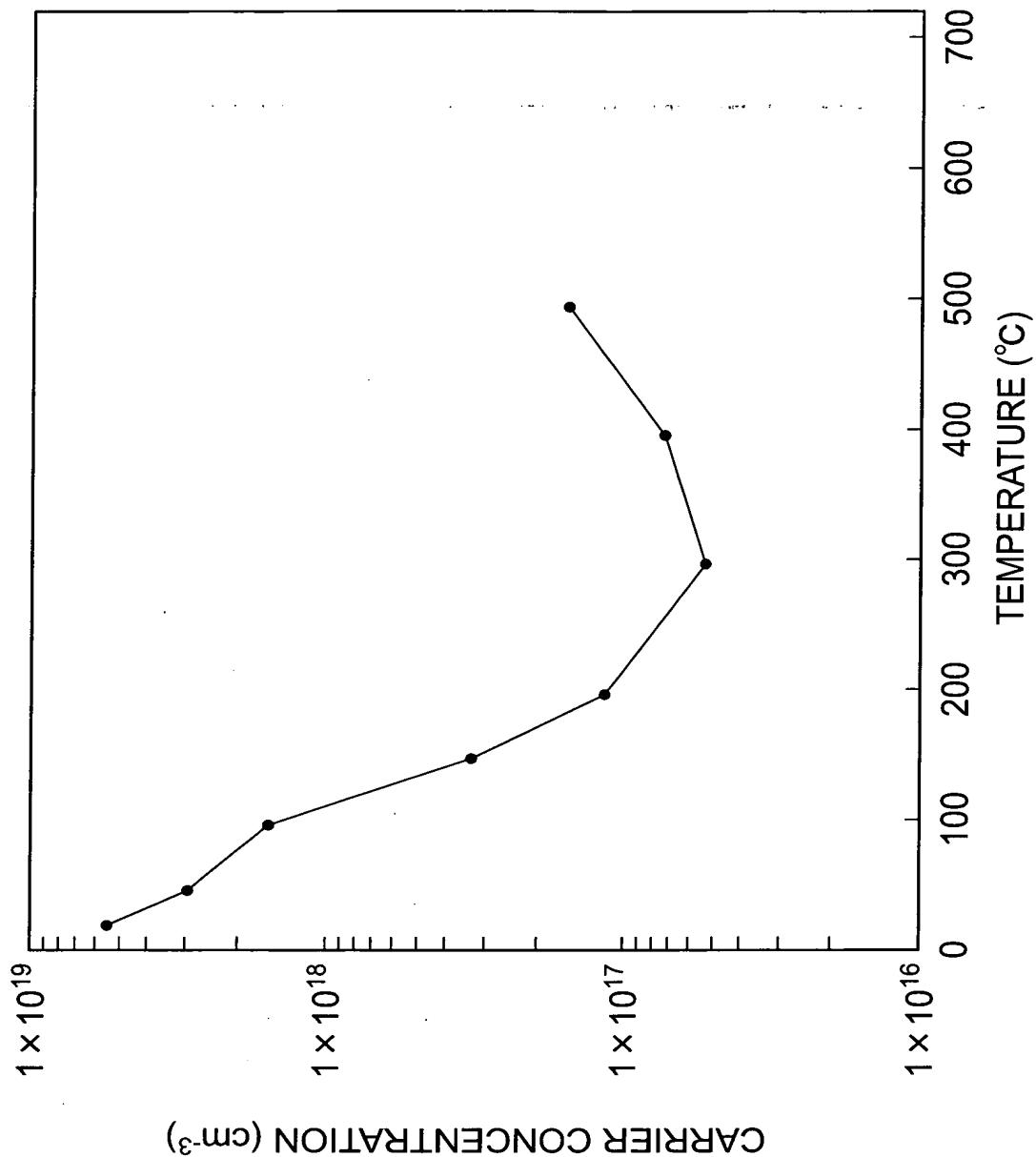


Fig. 3

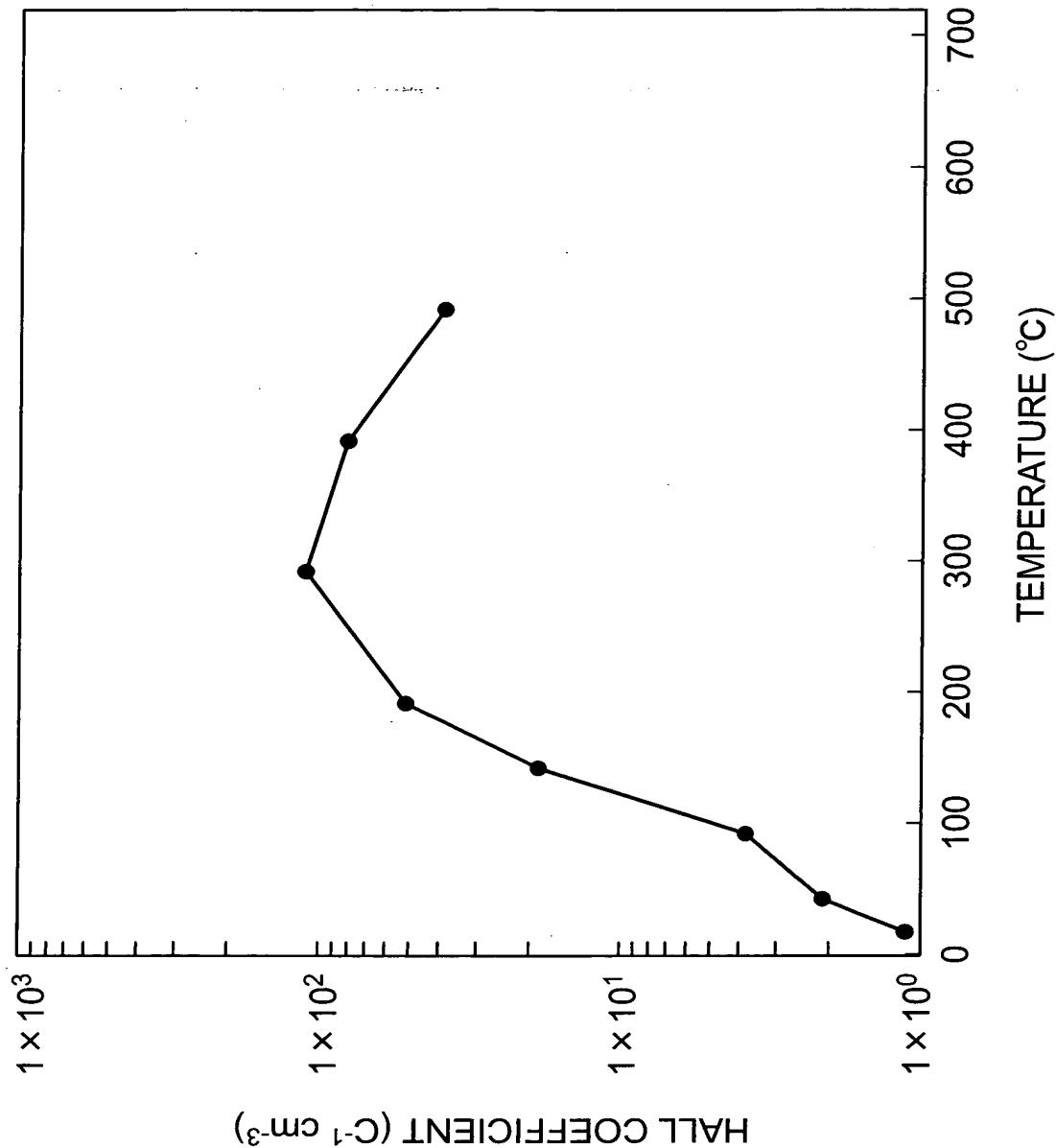


Fig.4

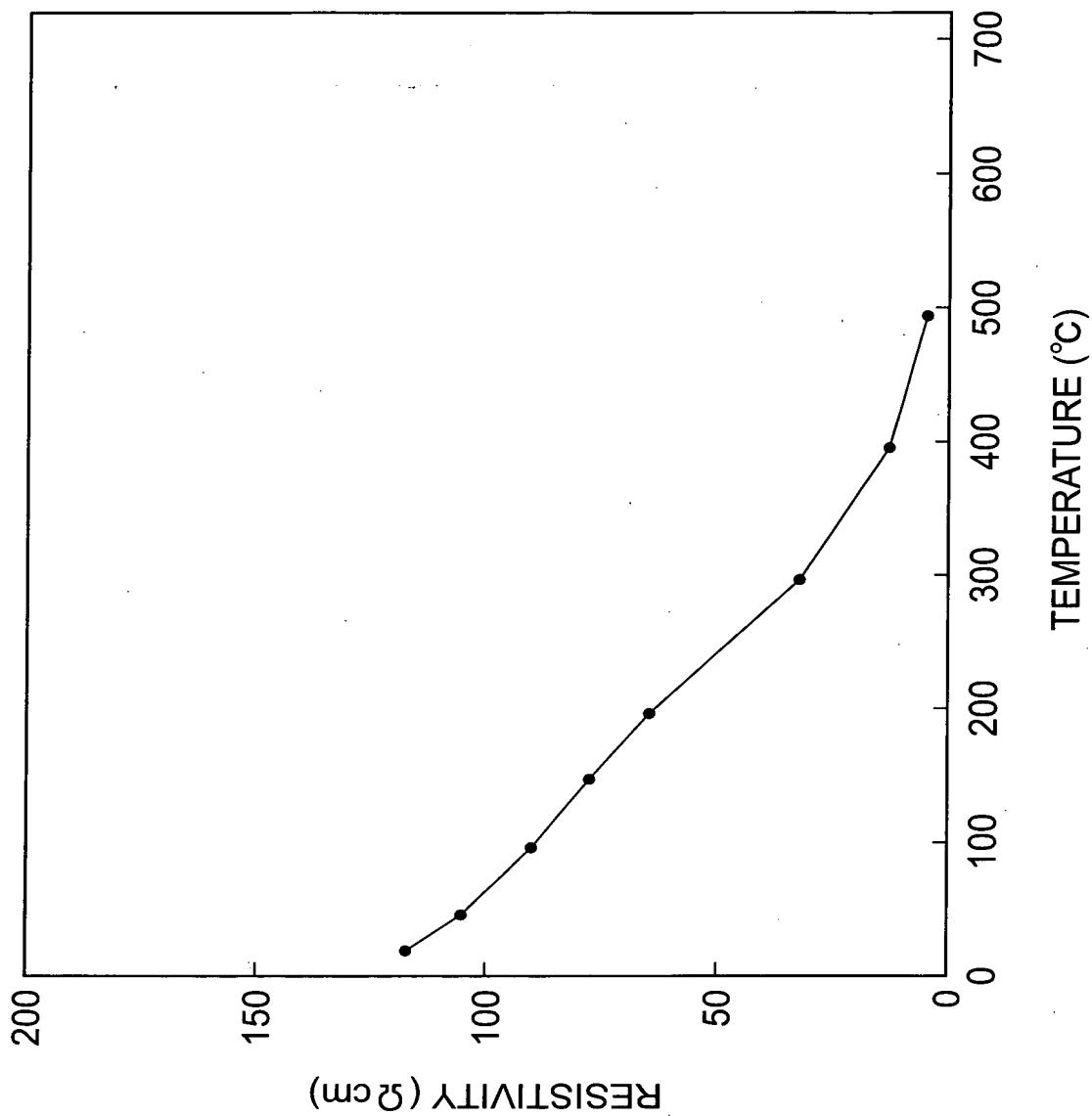
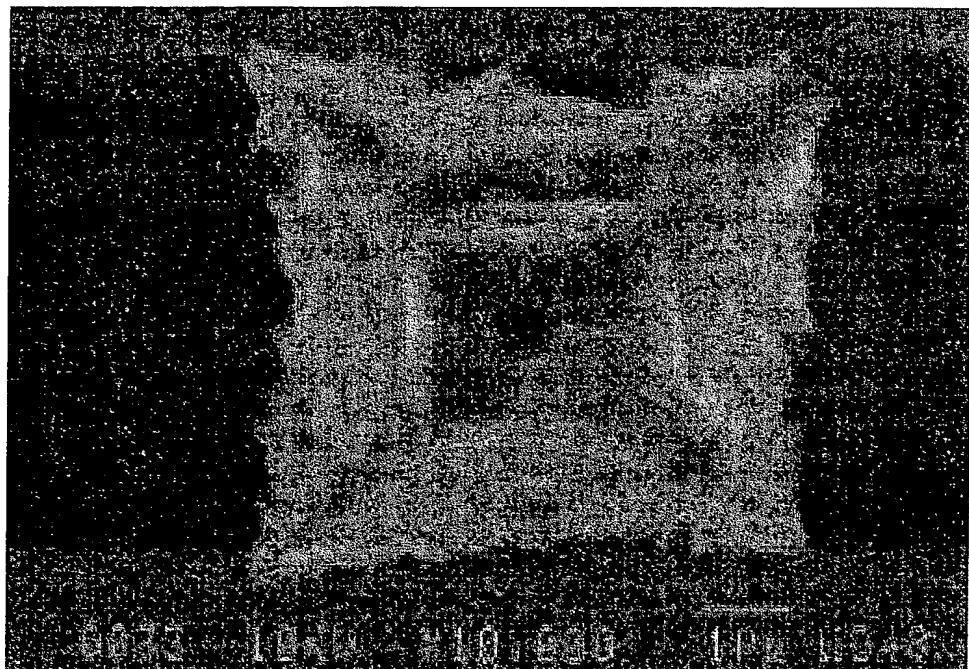


Fig. 5

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Fig.6



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Fig. 7

METHANE CONCENTRATION (CH_4/H_2) [%]	PHOSPHINE CONCENTRATION (PH_3/CH_4) [ppm]	N-TYPE DETERMINATION	CORRELATION OF CARRIER CONCENTRATION WITH TEMPERATURE	CORRELATION HALL COEFFICIENT WITH TEMPERATURE	MINIMUM CARRIER CONCENTRATION	RESISTIVITY AT ROOM TEMPERATURE	THRESHOLD VOLTAGE
0.05	200000	N-TYPE	+ (700°C ~ 350°C) - (350°C ~ 100°C)	- (700°C ~ 350°C) + (350°C ~ 100°C)	$\sim 5 \times 10^{15}$	100	400
0.03	200000	N-TYPE	+ (700°C ~ 350°C) - (350°C ~ 70°C)	- (700°C ~ 350°C) + (350°C ~ 70°C)	$\sim 8 \times 10^{16}$	80	350
0.005	200000	N-TYPE	+ (700°C ~ 350°C) - (350°C ~ 50°C)	- (700°C ~ 350°C) + (350°C ~ 50°C)	$\sim 2 \times 10^{17}$	50	300
1.0	220000	NOT DETARMINABLE	NOT OBSERVABLE	NOT OBSERVABLE			
0.5	220000	N-TYPE	+ (700°C ~ 300°C) ALONE	- (700°C ~ 300°C) ALONE	$\sim 4 \times 10^{15}$	800	1100
0.1	220000	N-TYPE	+ (700°C ~ 300°C) - (300°C ~ 180°C)	- (700°C ~ 300°C) + (300°C ~ 180°C)	$\sim 1 \times 10^{16}$	300	550
0.05	220000	N-TYPE	+ (700°C ~ 300°C) - (300°C ~ 100°C)	- (700°C ~ 300°C) + (300°C ~ 100°C)	$\sim 3 \times 10^{16}$	250	500
0.03	220000	N-TYPE	+ (700°C ~ 300°C) - (300°C ~ 50°C)	- (700°C ~ 300°C) + (300°C ~ 50°C)	$\sim 5 \times 10^{16}$	200	400
0.005	220000	N-TYPE	+ (700°C ~ 300°C) - (300°C ~ 30°C)	- (700°C ~ 300°C) + (300°C ~ 30°C)	$\sim 6 \times 10^{16}$	180	400
0.003	220000	NOT DETARMINABLE	NOT OBSERVABLE	NOT OBSERVABLE			
0.1	18000	N-TYPE	+ (700°C ~ 150°C) - (150°C ~ 60°C)	- (700°C ~ 150°C) + (150°C ~ 60°C)	$\sim 2 \times 10^{15}$	700	1000
0.05	18000	N-TYPE	+ (700°C ~ 100°C) - (100°C ~ 20°C)	- (700°C ~ 100°C) + (100°C ~ 20°C)	$\sim 1 \times 10^{15}$	900	1000
0.1	11000	N-TYPE	+ (700°C ~ 200°C) ALONE	- (700°C ~ 200°C) ALONE	$\sim 6 \times 10^{14}$	1000	1500
0.05	11000	N-TYPE	+ (700°C ~ 150°C) ALONE	- (700°C ~ 150°C) ALONE	$\sim 8 \times 10^{14}$	800	1100
0.05	1000	NOT DETARMINABLE	NOT OBSERVABLE	NOT OBSERVABLE			
0.05	1000	N-TYPE	+ (700°C ~ 30°C) ALONE	- (700°C ~ 30°C) ALONE	$\sim 3 \times 10^{13}$	20000	2000
0.03	1000	N-TYPE	+ (700°C ~ 30°C) ALONE	- (700°C ~ 30°C) ALONE	$\sim 4 \times 10^{13}$	20000	1800
0.005	1000	N-TYPE	+ (700°C ~ 30°C) ALONE	- (700°C ~ 30°C) ALONE	$\sim 6 \times 10^{13}$	15000	1500

Fig. 8

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METHANE CONCENTRATION (CH ₄ /H ₂) [%]	PHOSPHINE CONCENTRATION (PH ₃ /CH ₄) [ppm]	Si CONCENTRATION [cm ⁻³]	N-TYPE DETERMINATION	CORRELATION OF CARRIER CONCENTRATION WITH TEMPERATURE	CORRELATION HALL COEFFICIENT WITH TEMPERATURE	MINIMUM CARRIER CONCENTRATION	RESISTIVITY AT ROOM TEMPERATURE	THRESHOLD VOLTAGE
0.05	22000	1 × 10 ¹⁹	N-TYPE	+ (700°C ~ 300°C) -(300°C ~ 100°C)	- (700°C ~ 300°C) +(300°C ~ 100°C)	~ 4 × 10 ¹⁶	200	400
0.03	22000	8 × 10 ¹⁸	N-TYPE	+ (700°C ~ 300°C) -(300°C ~ 70°C)	- (700°C ~ 300°C) +(300°C ~ 70°C)	~ 6 × 10 ¹⁶	150	350
1	1000	3 × 10 ¹⁹	NOT DETERMINABLE	NOT OBSERVABLE	NOT OBSERVABLE			
0.5	1000	1 × 10 ¹⁹	N-TYPE	+ (700°C ~ 500°C) ALONE	- (700°C ~ 500°C) ALONE	~ 8 × 10 ¹⁴	1000	1100
0.1	1000	8 × 10 ¹⁸	N-TYPE	+ (700°C ~ 300°C) -(300°C ~ 150°C)	- (700°C ~ 300°C) +(300°C ~ 150°C)	~ 4 × 10 ¹⁶	400	600
0.05	1000	3 × 10 ¹⁸	N-TYPE	+ (700°C ~ 280°C) -(280°C ~ 80°C)	- (700°C ~ 280°C) +(280°C ~ 80°C)	~ 5 × 10 ¹⁶	200	450
0.5	5000	2 × 10 ¹⁸	N-TYPE	+ (700°C ~ 400°C) ALONE	- (700°C ~ 400°C) ALONE	~ 5 × 10 ¹⁴	1500	1500
0.1	5000	8 × 10 ¹⁷	N-TYPE	+ (700°C ~ 300°C) -(300°C ~ 150°C)	- (700°C ~ 300°C) +(300°C ~ 150°C)	~ 1 × 10 ¹⁶	500	700
0.05	5000	2 × 10 ¹⁷	N-TYPE	+ (700°C ~ 250°C) -(250°C ~ 50°C)	- (700°C ~ 250°C) +(250°C ~ 50°C)	~ 2 × 10 ¹⁶	300	500
0.5	1000	9 × 10 ¹⁸	N-TYPE	+ (700°C ~ 200°C) ALONE	- (700°C ~ 200°C) ALONE	~ 1 × 10 ¹⁴	7000	2000
0.03	1000	10 × 10 ¹⁶	N-TYPE	+ (700°C ~ 200°C) ALONE	- (700°C ~ 200°C) ALONE	~ 2 × 10 ¹⁴	4000	1800

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Fig. 9

METHANE CONCENTRATION (CH ₄ /H ₂) [%]	PHOSPHINE CONCENTRATION (PH ₃ /CH ₄) [ppm]	Si CONCENTRATION [cm ⁻³]	N-TYPE DETERMINATION	CORRELATION OF CARRIER CONCENTRATION WITH TEMPERATURE	CORRELATION HALL COEFFICIENT WITH TEMPERATURE	MINIMUM CARRIER CONCENTRATION	RESISTIVITY AT ROOM TEMPERATURE	THRESHOLD VOLTAGE
0.05	22000	2×10^{19}	N-TYPE	+ (700°C ~ 350°C) -(350°C ~ 80°C)	- (700°C ~ 350°C) +(350°C ~ 80°C)	$\sim 6 \times 10^{16}$	100	350
0.05	5000	8×10^{18}	N-TYPE	+ (700°C ~ 280°C) -(280°C ~ 50°C)	- (700°C ~ 280°C) +(280°C ~ 50°C)	$\sim 2 \times 10^{16}$	350	500
0.05	22000	9×10^{18}	N-TYPE	+ (700°C ~ 300°C) -(300°C ~ 100°C)	- (700°C ~ 300°C) +(300°C ~ 100°C)	$\sim 6 \times 10^{16}$	150	400
0.05	10000	1×10^{18}	N-TYPE	+ (700°C ~ 280°C) -(280°C ~ 80°C)	- (700°C ~ 280°C) +(280°C ~ 80°C)	$\sim 5 \times 10^{16}$	250	450
0.05	5000	4×10^{18}	N-TYPE	+ (700°C ~ 280°C) -(280°C ~ 90°C)	- (700°C ~ 280°C) +(280°C ~ 90°C)	$\sim 3 \times 10^{16}$	500	600